(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 346 671 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.09.2003 Bulletin 2003/39

(51) Int Cl.[7]: **A47C 20/04**, A47C 20/08, A61G 7/015, A61G 7/018

(21) Application number: **03251646.0**

(22) Date of filing: **18.03.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **18.03.2002 JP 2002075078**

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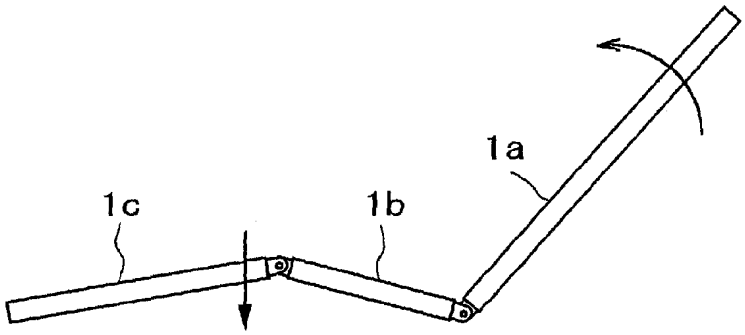
(54) Method of adjustment of a base structure for a bed or the like

(57) A method of controlling the coordinative raising of support portions of a base support for a bed or the like, the base support having a back-support portion (1a) for raising the back of a subject lying thereon and a leg-support portion (1b) for raising the knees of a subject lying thereon, in which the respective support portions are provided with respective lifting mechanisms, characterised in that a pressure detecting means (8) is interposed between the back-support portion (1a) and the back of the subject, wherein where the back-support portion (1a) is pivotally rotated and raised to an inclined position, the leg-support portion (1b) is also raised, wherein the leg-support portion (1b) is controlled to lower when the pressure applied from the back-support portion (1a) to the back of the subject and detected by said pressure detecting means (8) has increased to a preset value.

Fig.7



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Description

[0001] The present invention relates to a method of controlling the coordinative adjustment of a base structure for a bed or the like. More particularly, the present invention relates to a method of controlling the coordinative adjustment of a back-support portion for raising the back of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon.

[0002] As used in this specification, the term 'bed or the like' will be understood to include hospital trolleys, operating tables, stretchers and any other structure incorporating a horizontal surface on which a user may lie.

[0003] Many recent beds and the like have been provided with a back-support portion for raising the back of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon, each of the support portions being provided with respective lifting mechanisms by means of which the respective support portions are raised.

[0004] Many examples of such lying furniture can be seen, for example, in US Patent Nos. 5,469,591, 5,448,789, and 5,388,290.

[0005] For example, the bed described in US Patent No. 5,469,591 has a back-support portion for lifting the back of a subject lying thereon, a leg-support portion for lifting the knees of the subject, and other base structure support portions. On the undersides of the back-support portion and the leg-support portion, lifting arms each having a roller at the tip are installed, and are pivotally rotatable such that the lifting arms can be driven and rotated by electric drive mechanisms such as motors.

[0006] In this arrangement, the lifting arm of the back-support portion is pivotally rotated to allow the roller to lift the back-support portion in a pivotally rotating motion, to an inclined position, thereby lifting the back of the subject lying thereon, so that the subject can be moved into a more upright position.

[0007] When the back-support portion is lifted and inclined in this way, the lifting arm ofthe leg-support portion is pivotally rotated to allow the roller to lift the leg-support portion in a pivotally rotating motion, to an inclined position, thereby effectively preventing the subject lying thereon from sliding forward, which would occur if the back-support portion only were to be raised.

[0008] That is, in the case where the back of a subject lying on the support structure is raised to move the subject into a more upright position, if only the back-support portion is lifted, the body of the subject will gradually slide forward as the back of the subject is pressed forward by the back-support portion. As a result, the point at which the body of the subject can be easily bent shifts from the pivot of the back-support portion to a lumbar region and abdominal region of the subject which cannot easily bend as the back-support portion is raised, thereby resulting in feelings of discomfort to the subject.

[0009] By contrast, if the leg-support portion is raised when the back-support portion is raised, the body portion of the subject which is located above the inclined leg-support portion, i.e., the femoral regions of the subject, can receive the force applied from the back-support portion to the back of the subject which presses the subject forward. As a result, the sliding of the body of the subject and the resultant displeasure felt by the subject in the case where the back of the subject is raised by means of raising the back-support portion only, can be prevented.

[0010] It is known to raise the leg-support portion when raising the back-support portion of a base structure for a bed or the like. The conventional methods for raising the leg-support portion when lifting the back-support portion include, for example, the following:

[0011] As a first example, the drive mechanisms for lifting the back-support portion and the leg-support portion are operated respectively independently, and the subject lying on the bed, or a nurse, simultaneously or alternately turns on and off the respective drive mechanisms, using, for example remote control switches, to lift the back-support portion and the leg-support portion respectively to desired positions.

[0012] As a second example, a common motor or the like is used to drive the drive mechanisms of the back-support portion and the leg-support portion using an interlocking mechanism such as a link mechanism, so that the drive mechanisms of the back-support portion and the leg-support portion are actuated in a mechanically coordinative manner, to lift the back-support portion and the leg-support portion to predetermined positions.

[0013] However, these conventional methods have the following problems.

[0014] In method 1 above, the subject lying on the bed, or a nurse, must simultaneously or alternately operate the respective drive mechanisms of the back-support portion and the leg-support portion. This operation is very complicated and troublesome, and the operator must be accustomed to it. Furthermore, it is difficult to always reproduce the optimum lifting states for the back-support portion and the leg-support portion respectively.

[0015] In method 2 above, since an interlocking mechanism is used, the lifting states of the back-support portion and the leg-support portion achieved in an coordinative manner are inevitably simple and impossible to change, and it is difficult to efficiently prevent both the body of the subject from sliding and the subject feeling displeasure due to pressure from the raising portions applied to the lumbar and abdominal regions of the subject.

[0016] The present invention seeks to address the problems of the prior art by providing a base structure for a bed or the like provided with a back-support portion for raising the back portion of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon, each of the respective support portions being provided with a lifting mechanism for use in raising the respective support portions, wherein when the back-support portion is pivotally rotated to an in-

clined position, both sliding of the body of the subject and feelings of pressure which may be displeasing to the subject are avoided.

[0017] According to a first aspect of the present invention there is provided a method of controlling the co-ordinated raising of support portions of a base support for a bed or the like, the base support having a back support portion for raising the back of a subject lying thereon and a leg support portion for raising the knees of a subject lying thereon, in which the respective support portions are provided with respective lifting mechanisms, characterised in that a pressure detecting means is interposed between the back-support portion and the back of the subject, wherein when the back-support portion is pivotally rotated and raised to an inclined position, the leg-support portion is also raised, wherein the leg-support portion is controlled to lower when the pressure applied from the back-support portion to the back of the subject and detected by said pressure detecting means has increased to a preset value.

[0018] In this method, when the back-support portion is pivotally rotated and raised to an inclined position, the leg-support portion is also raised. Raising of the leg-support portion in this way supports the position of the waist of the subject lying on the base structure. Therefore, in this state, even if the back-support portion is raised and gradually inclined steeply, the subject is prevented from sliding forward.

[0019] If the raising of the back support portion and the leg support portion are continued further without control, the angle formed between the back support portion and the leg support portion would gradually decrease, with the result that the abdominal region of the subject would gradually become compressed and the subject would feel pressure around the abdominal region.

[0020] However, in a first aspect of this invention, the raising of the leg-support portion is not continued further without control. In the present invention, the pressure detecting means monitors the pressure applied from the back-support portion to the back of the subject, and when the pressure has increased to a preset value, the leg-support portion is controlled to lower, thereby avoiding the situation whereby the abdominal region of the subject is gradually compressed between the back support portion and the leg support portion resulting in the subject feeling pressure around the abdominal region as the angle formed between the back-support portion and the leg-support is prevented from becoming smaller than a certain angle.

[0021] As for the raising of the back-support portion and the raising of the leg-support portion to produce the above action, the raising of the back-support portion and the raising of the leg-support portion may be initiated simultaneously, or the raising of the back-support portion can be initiated first, or the raising of the leg-support portion can be initiated at first.

[0022] Preferably, when the raising of the leg-support portion is initiated first, when the back-support portion is pivotally rotated and raised to an inclined position, the leg-support portion positively supports the position of the waist of the subject from the beginning. Therefore, even if the raising of the back-support portion is initiated to make the back-support portion gradually more and more steeply inclined, the subject lying on the base structure is prevented from sliding forward.

[0023] Preferably, the preset value of pressure for the above-mentioned control action can be changed. In this way, the raising of the leg-support portion can be controlled in response to the specific sensitivity of the subject to pressure from the rising support portion.

[0024] Embodiments of the present invention will now be more particularly described, by way of example only, and with reference to the accompany drawings in which:

Figure 1 is a side view showing a section of a bed base to which the method of controlling the coordinative lifting of the support portions in accordance with the present invention is applied;

Figure 2 is an illustration showing, as an example, the control mechanism of the bed having a base structure to which the method of controlling the coordinative lifting of the support portions of the present invention is applied;

Figures 3 to 8 are side views showing a section of the bed base of Figure 1, at various phases in the lifting action where the method of controlling the coordinated raising of the support portions of the base structure, in accordance with the present invention is applied; and

Figure 9 is a diagram showing an example of how the inclination angles of the back-support portion and the leg-support portion change in relation to the elapsed time, in the case where the method of controlling the coordinative raising of support portions of a base structure in accordance with the present invention is applied.

[0025] Figure 1 is a side view showing, as an example, having a base structure to which the method of controlling the coordinative lifting of support portions of this invention is applied. The illustrated bed is composed of a back-support portion 1a for lifting the back portion of a subject lying thereon, a leg-support portion 1b for lifting the knees of a subject lying thereon, and a lower leg-support portion 1c corresponding to the lower leg of a subject lying thereon. The back-support portion 1a, the leg-support portion 1b and the lower leg-support portion 1c are connected with each other to form a bendable base structure corresponding to the whole body of the subject, and supported by a bed frame 2 (not shown). Furthermore, mattresses 3 are provided for the back-support portion 1a, the leg-support portion 1b and the lower leg-support portion 1c respectively. The mattresses 3 are separated in the drawing of Figure 1, but an integral mattress may also be used. The support mech-

anism for supporting and lifting the plural support portion of the base structure is not illustrated here since it is well known.

[0026] In the bed of this example, the base structure corresponding to the whole body of the subject lying thereon is composed of the above-mentioned divided three support portions 1a, 1b and 1c connected with each other. However, the base structure may also be divided into four portions, or as described, for example, in the aforementioned US Patent Nos. 5,469,591, 5,448,789 and 5,388,290, many support portions may be connected with each other to form a bendable base structure. The base structure to which this invention is applied is required to have at least a back-support portion for raising the back portion of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon.

[0027] Furthermore, the lifting mechanisms for raising the back-support portion 1a and the leg-support portion1b portion may be the mechanisms as described, for example, in the aforementioned US Patent Nos. 5,469,591, 5,448,789 and 5,388,290. That is, a lifting arm having a roller at the tip, which can be pivotally rotated by an electric drive mechanism such as a motor, can be installed to let the roller lift and support each base portion, or a linear motion member with a rotary motion-linear motion conversion mechanism consisting of a threaded shaft and a female screw engaged with it can be connected with an arm installed on the underside of each base portion.

[0028] The lifting mechanisms for lifting the back-support portion 1a and the leg-support portion 1b can be controlled to act in a co-ordinative manner as described later, or can be controlled to actuate the respective bottom sections individually as required.

[0029] An example of a base structure for a bed to which the method of controlling the coordinative lifting of support portions in accordance with this invention is applied is described with reference to Figures. 1 and 2. Symbol 4 denotes a footboard, and a control panel 5 is installed outside and below the footboard 4. The control panel 5 contains the control switches shown in Figure 2.

[0030] The control panel 5 contains switches SW1 and SW2 for lifting and lowering the back-support portion 1a and switches SW3 and SW4 for lifting and lowering the leg-support portion 1b. These switches allow the back-support portion and the leg-support portion to be lifted and lowered independently.

[0031] The control panel 5 also contains switches for lifting and lowering the back-support portion 1a and the leg-support portion 1b in a coordinative manner, i.e., lifting and lowering switches SW5 and SW6 in addition to the above-mentioned switches.

[0032] The back-support portion 1a has a pressure detecting means 8 interposed between the back of the subject lying thereon and the back-support portion 1a. The pressure detecting means 8 may take any suitable form provided it can detect the pressure applied from the back-support portion 1a to the back of the subject, and, for example, may consist of an air pouch and a pressure sensor for detecting the pressure in the air pouch.

[0033] Symbol 6 denotes a controller that controls the on and off actions of the motors M1 and M2 used for raising the back-support portion 1a and the leg-support portion 1b. The output signal of the pressure detecting means 8 is applied to the controller 6.

[0034] The control panel 5 has a pressure setting section SP for storing the preset value used for the controller 6 to judge whether the pressure applied from the pressure detecting means 8 reaches the preset value or not.

[0035] The above-mentioned arrangement used for the coordinative action in relation to the back-support portion and the leg-support portion is described below.

[0036] Figure 3 shows a state where all the support portions 1a, 1b and 1c are in a non-raised position, and in this state, a subject such as a patient lies in an ordinary supine position. To allow the lying subject to assume a more upright position in order to arise from the bed, the switch SW5 is turned on to issue a command to the controller 6.

[0037] Receiving the command, the controller 6 actuates first the lifting mechanism of the leg-support portion 1b as shown in Figure 4, to start raising the leg-support portion 1b only. The time instant when the lifting of the leg-support portion 1b is started is $t = 0$ in Figure 9.

[0038] Then, receiving another command, the controller 6 initiates the raising of the back-support portion 1a at the time instant ($t = T1$) suitably later than the time instant when the lifting of the leg-support portion 1b is initiated, and thereafter, as shown in Figure 5, both the back-support portion 1a and the leg-support portion 1b are further raised.

[0039] As described above, pivotal rotating and raising of the leg-support portion 1b is initiated before the raising of the back-support 1a from a non-raised position. Since the leg-support portion 1b is raised, the leg-support portion 1b supports the position of the waist of the subject, and therefore even if the lifting of the back-support portion is initiated in this state to gradually make the back-support portion steeply inclined, the subject is prevented from sliding forward due to pressure on the back of the subject from the back-support portion.

[0040] As described above, the raising of the leg-support portion 1b can also be initiated simultaneously with or later than the raising of the back-support portion 1a.

[0041] If the raising of the back-support portion 1a and the raising of the leg-support portion 1b are continued from the state shown in Figure 5 further without control, the angle formed between the back-support portion 1a and the leg-support portion 1b becomes gradually smaller to gradually bend the abdominal region of the lying person, finally resulting in the subject feeling discomfort due to the pressure of compression of the abdominal region.

[0042] However, in the present invention, the controller 6 keeps monitoring the pressure signals from the pressure detecting means 8 indicated by a broken line in Figure 9, and if the pressure reaches the pressure preset by the pressure setting means SP, the controller 6 acts to ensure that the raising of the back-support portion 1a is continued, but that the leg-support portion 1b is lowered.

[0043] Since the leg-support portion 1b is lowered in this way, even if the back-support portion 1a is further raised to form a sharp angle, the angle of the leg-support portion 1b gradually decreases. Therefore, the angle formed between the back-support portion 1a and the leg-support portion 1b does not become smaller, and therefore compression of the abdominal region of the subject is prevented and discomfort to the patient is avoided.

[0044] As a first method of detecting the time instant when the raising of the back-support portion 1a is initiated (T = T1) later than the time instant when the raising of the leg-support portion 1b is initiated (t = 0), and/or the time instant when the leg-support portion 1b reaches its highest position (t = T2), to ensure that the controller 6 can carry out the above-mentioned control action in the raising of the leg-support portion 1b and the raising of the back-support portion 1a, the time elapsed from the time instant when the raising of the leg-support portion 1b is initiated can be referred to for detecting said time instant.

[0045] In the case where the capacities of the drive sources such as motors for actuating the lifting mechanisms of the back-support portion 1a and the leg-support portion 1b are sufficiently larger than the forces necessary for lifting the back-support portion 1 a and the leg-support portion 1b on which the load of the subject lying thereon acts, or in the case where the load is constant, there is a direct correlation between the time elapsed after the time instant of actuating a lifting mechanism and the position of the corresponding lifted support portion 1a or 1b. So, the elapsed time provides a simple method by which to carry out the above-mentioned control action in response to the lifted position of the support portion 1a or 1b.

[0046] Therefore, in this case, if the values of T1 and T2 in the control means can be altered, it is possible to carry out a control action which is suitable for various conditions.

[0047] As a second method of detecting the time instant when the raising of the back-support portion 1a is initiated (T = T1) after the time instant when the raising of the leg-support portion 1b is initiated (t = 0), and/or the time instant when the leg-support portion 1b reaches its highest position (t = T2), to ensure that the control means can carry out the above-mentioned control action, a position detecting means such as an angle sensor can be installed to detect the position of the leg-support portion 1b. The position detecting means for the leg-support portion 1b can be installed at any suitable position, for example, at the leg-support portion itself, at the lifting mechanism or at the drive source such as a motor.

[0048] Also in this case, if arrangement is made to ensure that the respective positions can be preset, an adequate control action suitable for various conditions can be carried out.

[0049] The control action of the back-support portion 1a and the leg-support portion 1b to which this invention is applied has been described as an action in the case where the back-support portion is pivotally rotated and raised to an inclined position from a non-raised position. The action in the case where the support portions are lowered from an inclined position where the back-support portion is pivotally rotated and lifted, to a non-raised position, is reverse to the action explained for the case of raising the support portions and so no additional explanation is necessary.

[0050] Alternatively, in a further embodiment, the action in the case where the support portions are lowered from a raised position where the back-support portion is pivotally rotated and lifted, to a non-raised position may be different from the reverse action to the action explained for the case of lifting.

[0051] Furthermore, in the action for lowering, since the leg-support portion lifted to a certain position or the highest position is lowered thereafter, a similar action occurs when the leg-support portion is lowered. The leg-support portion in an inclined position prevents the subject from sliding forward whilst the base-support portion is an inclined position as it is being lowered, before being completely lowered to a non-raised position, with the result that once all the base portions have been returned to a non-raised position, the subject has not been slidably displaced. This has the advantage that the subject has been returned to a supine position without undue effort on the part of a care-giver.

[0052] As described above, a base support for a bed or the like for use in accordance with the present invention has a back-support portion for raising the back of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon, each of the respective support portions being provided with a lifting mechanism for use in raising the respective support portions, wherein when the back-support portion is pivotally rotated and raised to an inclined position from a non-raised position, the leg-support portion is also sufficiently raised.

[0053] In this case, the leg-support portion is controlled to be lowered when the pressure applied from the back-support portion to the back of the subject lying thereon and detected by said pressure detecting means rises to a preset value. Therefore, this invention exhibits the following effects.

[0054] When the back-support portion is pivotally rotated and lifted from a non-raised position, first the raising of the leg-support portion is initiated. The inclined leg-support portion serves to support the position of the waist of the subject. Therefore, even if the raising of the

back-support portion is initiated and the back-support portion raised to a steeply inclined position, the subject is prevented from sliding forward.

[0055] If the raising of the back-support portion and the raising of the leg-support portion are continued further without control, the angle formed between the back-support portion and the leg-support portion becomes gradually smaller, resulting in the compression of the abdominal region of the subject, leading to feelings of pressure which may be displeasing to the subject. However, in this invention, the raising of the leg-support portion is not continued further without control, and said pressure detecting means monitors the pressure applied from the back-support portion to the back ofthe subject lying thereon, so that when the pressure rises to a preset value, the leg-support portion can be controlled to lower. Therefore, since the leg-support portion is maintained at or below the preset position, the angle formed between the back-support portion and the leg-support portion cannot become smaller than a certain angle and the situation whereby the abdominal region of a subject becomes gradually compressed leading to feelings of pressure is avoided.

Claims

1. A method of controlling the coordinative raising of support portions of a base support for a bed or the like, the base support having a back-support portion for raising the back of a subject lying thereon and a leg-support portion for raising the knees of a subject lying thereon, in which the respective support portions are provided with respective lifting mechanisms, **characterised in that** a pressure detecting means is interposed between the back-support portion and the back of the subject, wherein where the back-support portion is pivotally rotated and raised to an inclined position, the leg-support portion is also raised, wherein the leg-support portion is controlled to lower when the pressure applied from the back-support portion to the back of the subject and detected by said pressure detecting means has increased to a preset value.

2. A method according to Claim 1 wherein when the back-support portion is pivotally rotated and raised to an inclined position, the raising of the back-support portion and the raising of the leg-support portion are initiated simultaneously.

3. A method according to Claim 1, wherein when the back-support portion is pivotally rotated and raised to an inclined position, first the raising of the back-support portion is initiated and at a time instant suitably later than the time instant at which the back-support portion is raised, the raising of the leg-support portion is initiated.

4. A method according to Claim1, wherein when the back-support portion is pivotally rotated and raised to an inclined position, first the raising of the leg-support portion is initiated, and at a time instant suitably later than the time instant when the raising of the leg-support portion is initiated, the raising of the back-support portion is initiated.

5. A method according to Claim 1, wherein the preset value of the pressure detecting means can be altered.

Fig.1

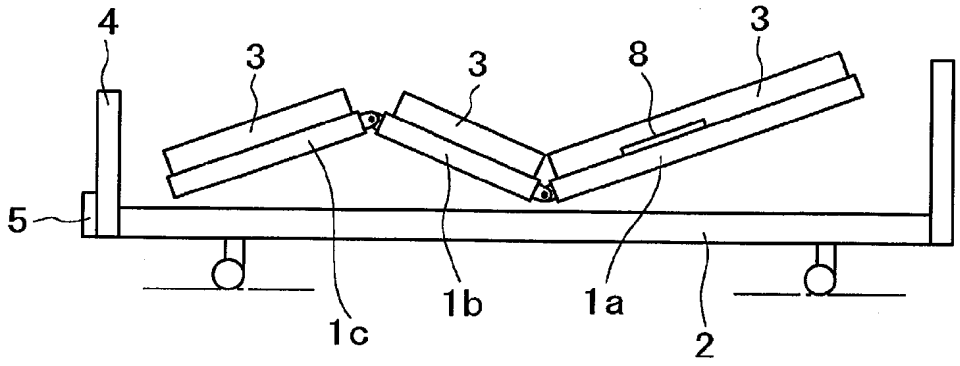


Fig.2

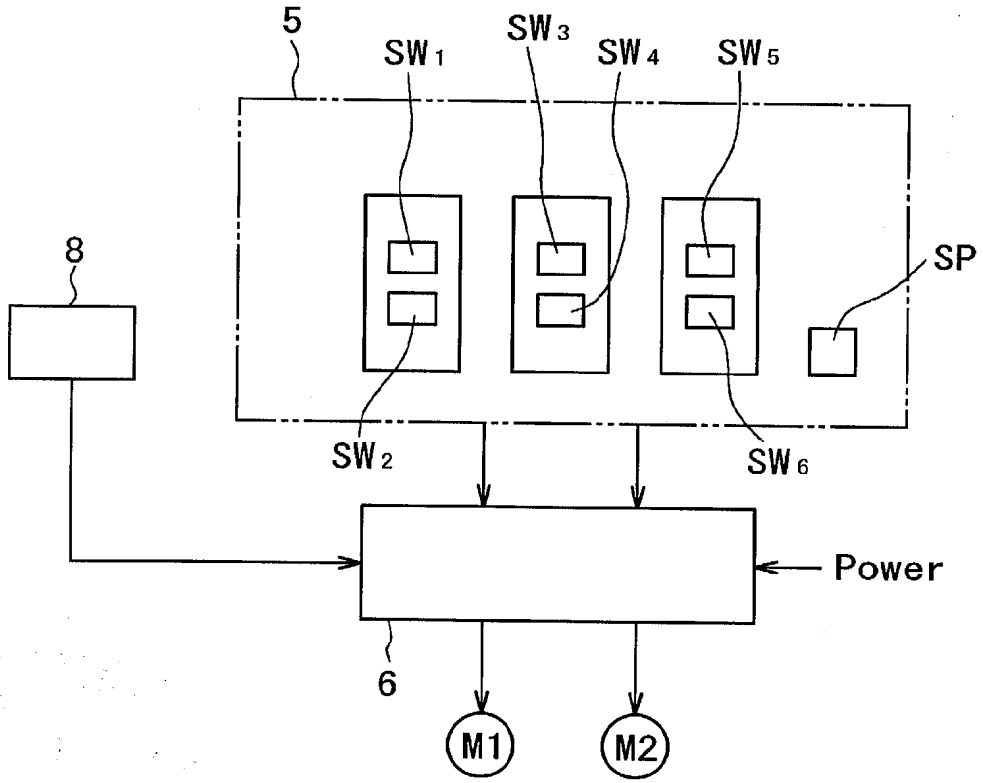


Fig.3

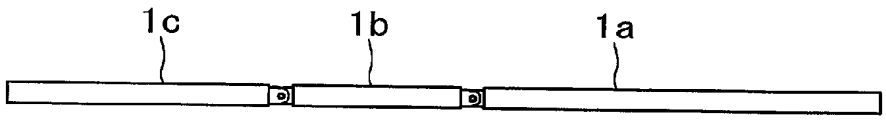


Fig.4

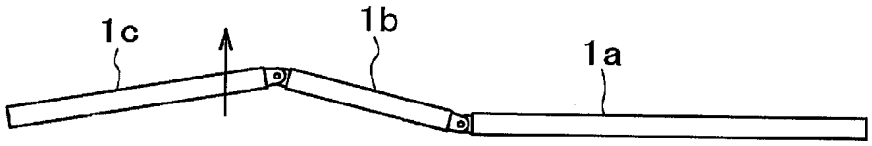


Fig.5

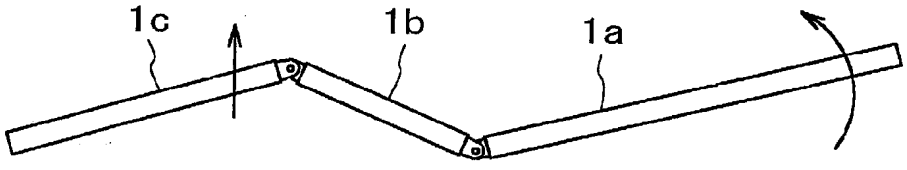


Fig.6

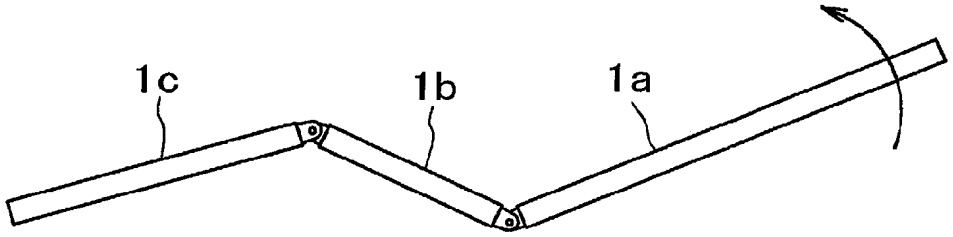


Fig.7

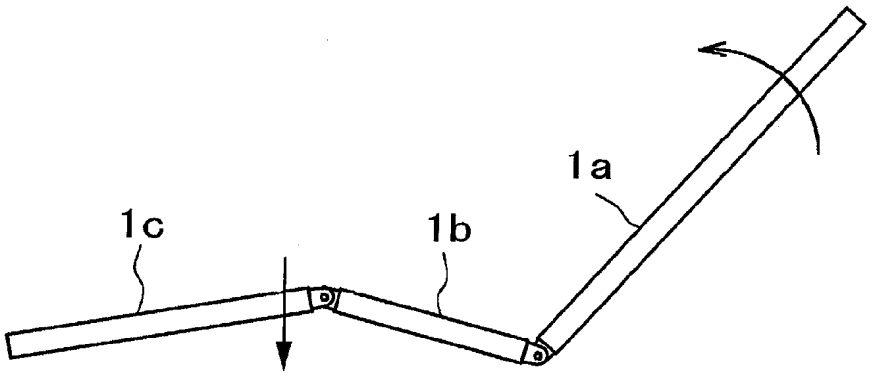


Fig.8

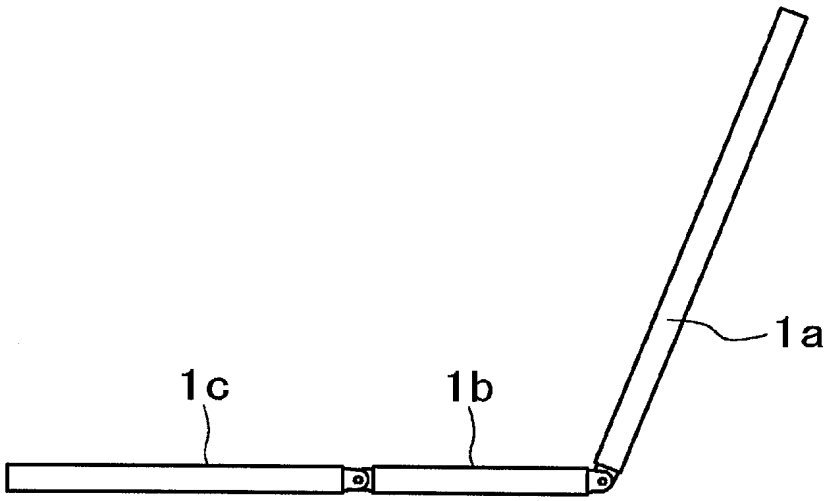
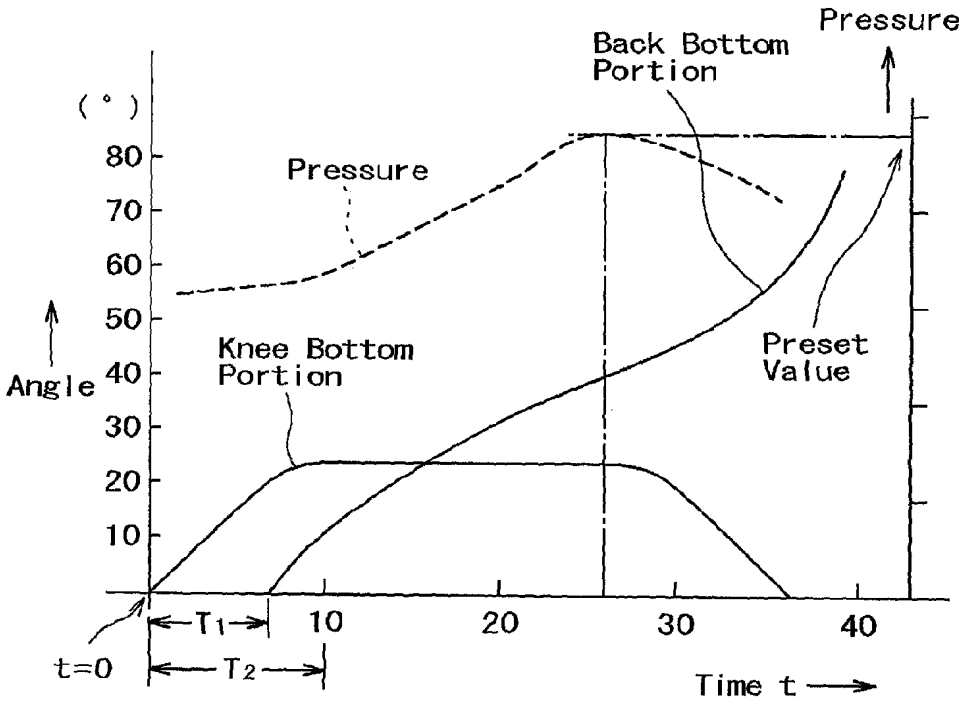


Fig.9


Pressure
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Pressure
(°)
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Preset Value
T1
T2
10
20
30
40
t=0
Time t

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 1646

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 1 180 352 A (MATSUSHITA SEIKO KK ;SOEJIMA NOBORU (JP)) 20 February 2002 (2002-02-20)	1,5	A47C20/04 A47C20/08 A61G7/015
A	* paragraph [0259]; figures *	3,4	A61G7/018
A	US 5 283 735 A (GROSS CLIFFORD M ET AL) 1 February 1994 (1994-02-01) * abstract; figures *	1	
A	US 4 769 584 A (IRIGOYEN MARIO J ET AL) 6 September 1988 (1988-09-06) * column 7, last paragraph *	1	
A	WO 01 91689 A (HAYES STEPHEN ;BEASLEY MICHAEL (GB); HOLLYOAK STEPHEN (GB); HUNTLE) 6 December 2001 (2001-12-06) * page 6, line 27; figures *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

A47C
A61G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 June 2003	Amghar, N

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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